



NRI research highlights

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High-Fertility Proteins Enhance Reproduction Rates in Dairy Cattle

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Efficient reproduction is critically important to the financial success of the dairy cattle industry. Heifer calves produced each year serve as future replacements for older milking cows that have been retired.

To maximize milk production, cows must become pregnant and give birth to calves as often as possible. Delays in entering a lactation cycle due to reproductive failure result in lost income from reduced milk sales.

More than 70% of the dairy cows in the United States are bred by artificial insemination, using genetically superior sires. On average, only about 50% of these matings result in calf births.

Numerous factors can affect the success of cattle reproduction. Researchers at The Pennsylvania State University are

studying how specific proteins in the male and female reproductive tracts influence the fertility of sperm from dairy bulls.

These scientists are studying extensive data to document the fertility of individual dairy bulls used for artificial insemination. Their work is funded in part by USDA's National Research Initiative (NRI) Competitive Grants Program.

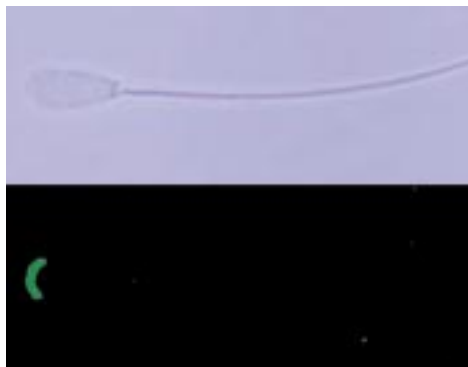
ASSESSING FERTILITY

Assessing the fertility of dairy bulls is done by using their semen to inseminate thousands of females, a task made possible only through artificial insemination and good record keeping. Because the fertility of individual bulls is known, comparisons are possible between the protein composition of the seminal fluid (in which sperm are suspended) from bulls with high and low fertility.

Penn State researchers discovered that seminal fluid from bulls with high fertility typically contains two proteins in greater amounts than seminal fluid from bulls with low fertility.

Identifying the proteins in seminal fluid associated with fertility involves determining the sequence of amino acids – or pro-

A PHASE CONTRAST IMAGE OF A BULL SPERM (TOP) AND A DARK FIELD IMAGE OF THE SAME SPERM WITH FLUORESCENCE MARKING THE LOCALIZATION OF PROSTAGLANDIN-D-SYNTHASE.



DON WAGNER AND ROBYN GERENA

*Researchers
identified two
proteins associated
with high fertility.*

tein building blocks – which are unique to each protein. This process is tedious because the proteins associated with variations in fertility represent less than 1% of all of the proteins present in seminal fluid.

PROTEINS IDENTIFIED

Working with colleagues at the National Institutes of Health and the Osaka Bioscience Institute in Japan, the researchers identified the two proteins associated with high fertility as osteopontin and prostaglandin-D-synthase.

The major challenge now confronting Penn State scientists is to understand how the high-fertility proteins actually improve the fertility of dairy bulls. Researchers are currently preparing large quantities of pure osteopontin and prostaglandin-D-synthase by genetic engineering and recombinant DNA technology to characterize the function of these proteins.

The scientists are conducting additional laboratory tests to determine whether treating sperm with osteopontin or prostaglandin-D-synthase improves the rate of fertilization and embryo development. As new basic information becomes available on how these proteins enhance

fertility, practical applications are likely to emerge.

The scientists will conduct field trials to determine if treating sperm from low-fertility bulls with osteopontin and/or prostaglandin-D-synthase prior to insemination boosts fertility and increases pregnancy rates in cows. They are also planning to develop diagnostic tests to identify bulls with high or low fertility.

IMPACT

These developments are likely to improve pregnancy rates in dairy cattle, ultimately resulting in increased efficiency and profits for the dairy cattle industry.

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